Section 8.1
VEGETATED SWALES
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Vegetated swales are broad shallow earthen channels with a dense stand of vegetation. The combination of low velocities and vegetative cover promotes settlement of particulates and some degree of treatment by infiltration. The judicious use of low velocity swales can also help attenuate the volume and peak rate of runoff.

The use of check dams and wide depressions in swales increase runoff storage and promote greater settling of pollutants. Check dams create small infiltration pools along the length of the swale, which are used to retard and temporarily impound runoff to induce infiltration and promote filtering and settling of nutrients and other pollutants. Because of their limited ability to remove dissolved pollutants, vegetated swales should generally be viewed as pre-treatment systems. Grass filter systems are generally most effective when used in combination with other BMPs. Designers should seriously consider integrating redundant pollutant removal enhancement features such as stilling basins, stone infiltration or low-flow trenches, and check dams into swale systems (Galli, 1993). A typical vegetated swale with check dams is shown in Figure 8-1.

8.1.1 Site Suitability Criteria

1. Applicability: Vegetated swales are most applicable in residential or institutional areas where the percentage of impervious cover is relatively small. While swales are generally located along rear or side property lines of residential lots, they are also used along roadways instead of curbs and gutters. Roadside

IMPORTANT
Design Tips

- Provide increased swale widths and flatter cross-sections if the swale must be crossed or maintained with large equipment.
- Provide 15 foot easements on either side of the swale to allow access by heavy equipment.
- A flow velocity of 1 foot per second (fps) will provide the greatest water quality benefit. Higher velocities are permissible for channel stability, but could result in resuspension of settled particulates. The maximum allowable Q_{10} velocity should be less than 3 fps.
- Provide a minimum of 2 feet of soil between the bottom of the swale and the top of an underdrain pipe, if used.
- Provide scour protection downstream of checkdams.
- Design check dams should be designed to infiltrate ponded water behind them within 12 hours.

swales become less feasible as the number of driveways requiring culverts for swale crossings increases.

2. Slopes: Areas with steep slopes may limit the use of swales. In such areas, swales should parallel the contour, in effect becoming diversions. If the slopes are too steep, the construction of low velocity swale cross sections may involve excessive disturbance of existing grades to provide stable backslopes.

3. Flow Volume/Velocity: Vegetated swales are most effective when the flow depth is shallow and the velocities are low.

4. Using Natural Swales: Existing channels should only be used when they are shown to conform with the same design requirements that apply to new facilities. Existing ditches should be checked to ensure that they have adequate capacity and that their channels are stable. Gullied, natural channels should be avoided where they are impractical to stabilize.

8.1.2 Design and Construction Criteria

1. Soils: Soils should be suitable or be amended to establish a vigorous stand of vegetation. If dense vegetation cannot be maintained in the swale, its effectiveness will be severely reduced. Sites on A or B hydrologic group soils will be more effective for infiltration, although swales on other soils will still provide some treatment through sedimentation.

2. Flow Duration: To be effective in removing stormwater pollutants, swales must not be subjected to low flows of long duration and not kept wet for long pollutant removal as constant wetness will keep the soil saturated and may kill the vegetation reducing pollutant removal. The success of a swale system is enhanced by good stormwater management throughout its watershed. Good management practices reduce the peak rate of runoff and the volume of water to be carried, infiltrated, or filtered by the waterway. Effective erosion control practices will limit the pollutant loading to the waterway.

3. Equipment Access and Crossings: If the swale or waterway must be crossed or maintained with large equipment, the width should be increased and flatter cross-section incorporated into the design. Large mowing equipment may require a significant increase in width over that needed for hydraulic capacity and freeboard. This problem deserves careful study in each project area so that the proper modifications are made in swale width and side slopes to meet the needs of equipment common to the locality. Easements of sufficient width to allow access by equipment (typically 15 feet minimum) must be provided on either side of the swale.

4. Wildlife Habitat: In order to increase the wildlife habitat potential of these systems, it is recommended that an additional, minimum 10-12 foot wide, no-mow buffer strip be incorporated into their design. This buffer strip should be located between the swale and developed areas, and could be planted with a variety of food-producing grasses/small shrubs and/or native wildflowers. This buffer can also serve as a physical separation from other lawn areas in order to discourage equivalent levels of mowing.

5. Flow Velocity: The channel should be designed for low velocity flow. A velocity of 1 fps is the maximum design storm flow velocity recommended when vegetated swales are being designed as a BMP. Higher velocities might be permissible for channel stability, but could result in resuspension of settled particulates. The maximum allowable Q10 velocity should be less than 3 fps.

6. Flow Depth: Flow depths in the swales should be minimized to increase the amount of vegetative filtering and settling. A maximum design flow depth of 1 foot is suggested. This will generally result in wide, shallow channel designs.

7. Minimum Channel Dimensions: The minimum width of the flat bottom of a trapezoidal channel shall be at least 3 times the channel depth. Non-trapezoidal channels should have similar depth to width relationships. Channel side slopes shall not exceed 3 (horizontal):1 (vertical) for seeded or sodded slopes, or 2:1 for riprap slopes, although the channels may be parabolic or trapezoidal (Maryland, 1984). A V-shaped swale is not recommended.

8. Vegetation: Vegetation for swale linings should be selected based on soils and hydrologic conditions at the site, in accordance with applicable Erosion and Sediment Control BMPs described in the Maine Erosion and Sediment Control BMPs, (2003). Recommended grasses include Ky-31 tall fescue, reed canary grass, redtop, rough stalked blue grass, and mixtures thereof (Galli, 1993).

9. Construction Considerations: Construct and stabilize the waterway in advance of any other channels or facilities that will discharge into it. Divert all flow from the waterway during the establishment period.

10. Use with Check Dams: The use of swales with check dams can enhance the pollutant removal efficiency. The following criteria should be followed when incorporating check dams into swales:

a. Separation from Seasonal High Water Table & Bedrock: The recommended depth to seasonal high groundwater or bedrock for a swale using check dams is a minimum of 3 feet.

b. Use with infiltration trenches: The use of swales with check dams can enhance the effectiveness of infiltration trenches when constructed above the trenches. The pool created by each check dam increases the volume of runoff infiltrated into the trench, while the vegetated swale helps to filter out suspended solids and other runoff pollutants. Refer to Chapter 6 Infiltration BMPs.

c. Alternative to curb and gutter design: Swales with check dams are excellent alternatives to conventional curb and gutter design for roadways and are generally less expensive to install, where road gradients and availability of land within or adjacent to the right-of-way allow.

d. Check Dam Design: The check dam should be constructed of durable rock or rock-lined material so that it will not erode. The area just downstream of the check dam should be protected from scour with properly designed rock riprap or protective channel lining. The check dam may have a solid level surface integrated into it for added durability. Check dam heights are generally 6 to 12 inches, depending on channel slope and desired storage capacity. The check dams should be notched or ported to allow the flows in excess of their infiltrative capacity to be bypassed. Check dams should be designed so that the water ponded behind them will infiltrate in 12 hours or less (Galli, 1993).

8.1.3 Maintenance

1. Mowing: Grass should not be trimmed extremely short, as this will reduce the filtering effect of the swale (MPCA, 1989). The cut vegetation should be removed to prevent the decaying organic litter from adding pollutants to the discharge from the swale. The mowed height of the grass should be 2-4 inches taller than the maximum flow depth of the design water quality storm. A minimum mow height of 6 inches is generally recommended (Galli, 1993).

2. Routine Maintenance and Inspection: The area should be inspected for failures following heavy rainfall and repaired as necessary for newly formed channels or gullies, reseeding/sodding of bare spots, removal of trash, leaves and/or accumulated sediments, the control of woody or other undesirable vegetation and to check the condition and integrity of the check dams.

3. Aeration: The buffer strip may require periodic mechanical aeration to restore infiltration capacity. This aeration must be done during a time when the area can be reseeded and mulched prior to any significant rainfall.

4. Erosion: It is important to install erosion and sediment control measures to stabilize this area as soon as possible and to retain any organic matter in the bottom of the trench.

5. Fertilization: Routine fertilization and/or use of pesticides is strongly discouraged. If complete re-seeding is necessary, half the original recommended rate of fertilizer should be applied with a full rate of seed.

6. Sediment Removal: The level of sediment deposition in the channel should be monitored regularly, and removed from grassed channels before permanent damage is done to the grassed vegetation, or if infiltration times are longer than 12 hours. Sediment should be removed from riprap channels when it reduces the capacity of the channel.

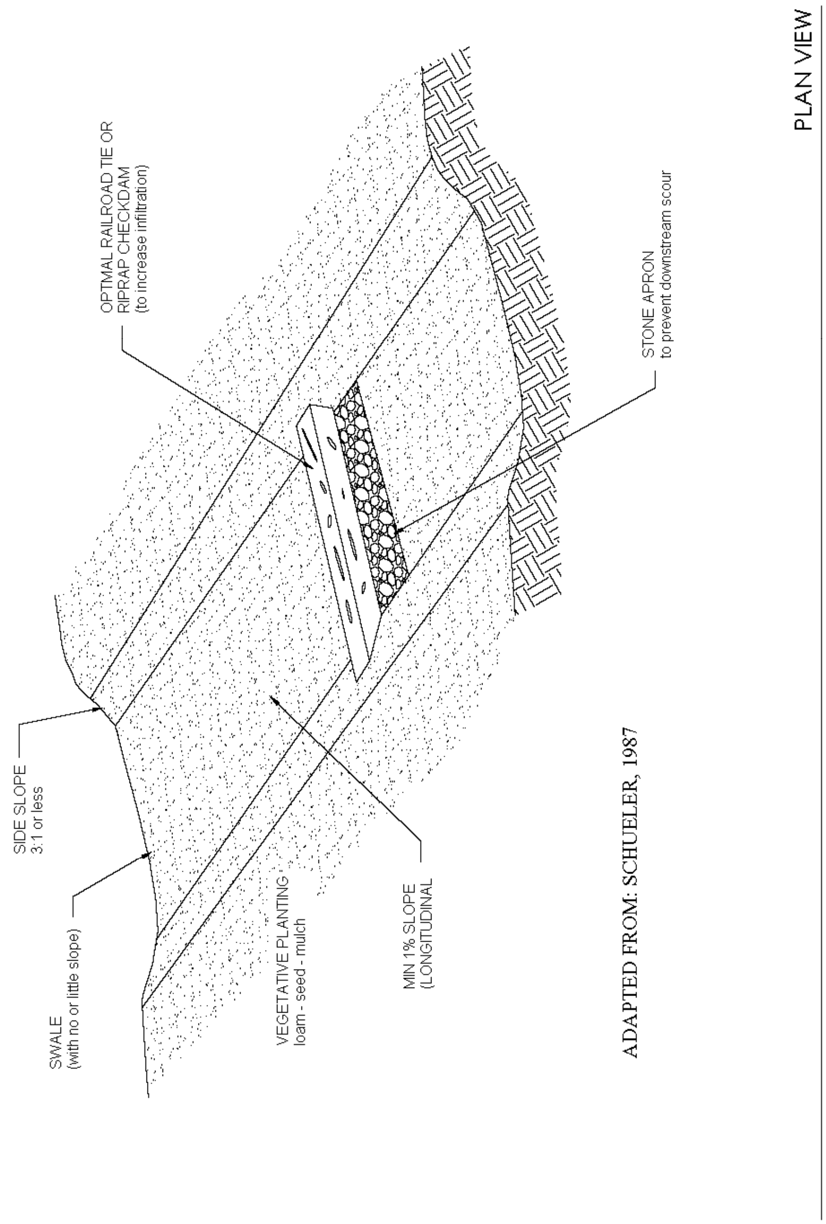

FIGURE 8-1. TYPICAL SWALE WITH CHECKDAMS